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Detection and Filtering of Landmark Occlusions using Terrain Spatiograms

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Overview
A team of robots cooperating to quickly produce a map needs to share landmark information between team members so that the local maps can be accurately merged. However, a landmark visible to one robot may be partially occluded to another.

Terrain Spatiograms are a landmark representation in which the image spatial information relates to the scene rather than the image. This makes it possible to identify and filter potential landmark occlusions.

We present an approach to identifying and filtering occlusions using Terrain Spatiograms, and we report experimental results on 20 landmark datasets for varying states and filter potential landmark occlusions.

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However, a landmark visible to one robot may be partially occluded to another.

This landmark occlusion detection and filtering method was evaluated on a collection of occluded and unoccluded landmarks (show in the image table below). Terrain spatiograms of corresponding unoccluded and occluded landmarks were compared before and after occlusion filtering.

Matching Occluded Landmarks
- A visibility vector \( V \) is calculated to trim away the occlusions
- Both landmark spatiograms \( h \) and candidate landmark spatiogram \( h' \) are translated to the origin for comparison, \( h' \) and \( h'' \), respectively.
- Only the depth \( z \) information is used to translate the candidate landmark:
- Each is renormalized about the location of intersection of their visibility vectors.
- The filtered candidate and landmark are compared using the normalized comparison.

Results

Conclusions
- Introduced an approach to identifying landmark occlusions using Terrain Spatiograms.
- Presented a procedure to match occluded landmarks against candidate landmarks.
- Demonstrated results showing the method is effective for a set of indoor landmarks with a range of occlusions.